The present invention is directed to a process for manufacturing a polymer fiber composite tube clamp in which a continuous fiber-reinforcing material is layered in a single layup and cured in a single curing operation. An important aspect of the invention is that the continuous fiber-reinforcing material is layed up to the contour of the layup tooling. The continuous fiber-reinforcing material adjacent to the part to be clamped is planar, with the fibers lying in a plane that is parallel to the surface of the clamp. This is an important aspect of the invention, since when the fibers are layed up to the contour of the tooling, that is, in a plane parallel to the surface of the clamp, they do not project out of this plane and to the surface of the clamp. Because the molded tube clamp is not machined to its final contoured shape after molding, no fiber ends are exposed. These factors prevents exposed fiber ends which abrade and cause wear on the clamped tube. Additionally, the molded tube clamp, not being machined, is less likely to delaminate or crack, because the predetermined layup can take advantage of the directional strength of the planar sheets of material.

Rejection under 35 U.S.C. §112

Claims 1-12 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. The Examiner states:

> It is unclear what is meant by "net shape" as the term is not defined in the specification.
>
> Regarding claim 11, resin transfer molding does not use pre-impregnated sheets of material as shown by applicant's own specification, which lists it as an alternative to pre-impregnated sheets. (Pg. 10, ll. 6-7) It is unclear how a technique used with dry fiber sheets can use pre-impregnated sheets.

Applicants respectfully traverse this rejection. The terms "net shape" and "near net shape" are terms of art in the field of composites, well known to routiners in the art. As evidence of this, Applicants submit a copy of Metals Handbook, Volume 21 entitled "COMPOSITES", p. 594, which discusses the production of large complex shapes produced in a near-net shape and p.1044, which discusses "net shape, integrally processed multifunctional parts. Copies of these pages are reproduced and submitted as an attachment to this response for the convenience of the Examiner. A "net shape" is a pattern required to produce the part with no material waste, while a

"near net shape" produces some excess material which must be removed. Furthermore, a search of the internet discloses clearly that the term "net shape" is a well-known and accepted term in the materials art. A copy of a web page defining the term: "Net shape processing refers to any manufacturing process which creates an object in its finished form *without* the need for finish machining or other actions" from the Internet Science and Technology Fair of the University of Central Florida's College of Engineering and Computer Science is provided as further evidence. Based on the clear understanding of the term as the term is used by those skilled in the art, Applicants respectfully request withdrawal of the rejection that the term "net shape" is unclear, as the submitted references clearly indicate that one skilled in the art has clearing meaning of this term.

Applicants have reviewed the Examiner's rejection regarding claim 11 and have amended claim 11 to overcome the Examiner's rejection of claim 11. Claim 11 now clearly sets forth the steps of resin transfer molding, which process was originally claimed as a dependent step. While resin transfer molding is an alternative for the product made by the present invention, it does not include a step having sheets of curable material (i.e. prepreg).

Rejection under 35 U.S.C. §103(a)

Claims 1-5 and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wiley (U.S. Patent No. 4,435,506) in view of Alston et al. (U.S. Patent No. 6,103,864) and Clark et al (U.S. Patent No. 6,139,346). The Examiner states:

> Wiley discloses forming tube clamps by compression molder fiber-reinforced polymer in the shape of a tube clamp and then removing the shaped material from the mold (Col. 3, ll. 44-57). While the reference discloses polyamide, a thermoplastic, the material listed, PMR-15, is a mixture of polyimide and carbon fibers as shown by Alston et al. (Col. 1, ll. 33-36) Clearly, the use of Polyamide rather than polyimide is a spelling mistake in Wiley. Thus, the material used , PMR-15, is a thermosetting material, i.e. is curable. One in the art would understand that the material was cured as that is how thermosetting materials are used.
>
> The reference also does not disclose stacking multiple sheets of material in the mold to form the tube clamp. However, stacking multiple sheets in a mold to form an article is well-known and conventional in the bonding arts as shown for

example by Yamamoto et al. which discloses stacking multiple sheets in a mold. (Figure 5)

Regarding claim 2, Wiley suggests using randomly oriented fiber plies in the clamp, but the specific materials used do not appear to be integral to the claim formation. Yamamoto et al. discloses that random fibers can create a roughened surface in the final product that uses continuous fibers instead. (Col. 1, ll. 58-60; Col. 3, ll. 3-7) It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace the random fibers of Wiley with the continuous fibers of Yamamoto et al. since this would create a cleaner surface on the clamp and since Wiley's use of random fibers is only suggested.

Regarding claim 3, while Wiley suggests the use of randomly oriented fibers, this is clearly only exemplary, and other well-known and conventional materials may be used. Woven material impregnated with resin are well-known and conventional alternatives in the art to nonwovens impregnated with resin and it would have been obvious to one or ordinary skill in the art at the time the invention was made to used either woven or nonwoven materials to form the clamp since both are well-known alternatives in the art.

Regarding claim 4, Wiley discloses the sheets contain randomly oriented fibers. (Col. 3. ll. 49-50)

Regarding claims 10 and 11, Wiley discloses the sheet is compression molded (Col. 3, ll. 50-51) but not the exact type of apparatus used. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any well-known and conventional molding apparatus in the process of Wiley such as autoclaving and using a metal press as these are all well-known and conventional alternatives in the art for compressing and molding a sheet to a desired shape.

Regarding claim 12, Wiley discloses using the process to make clamp. One in the art would understand that the claim would have two halves, both made via the same molding technique.

Applicants respectfully traverse this rejection. First, Applicants note that a polyamide is a different material from a polyimide. However, presumably Wiley, being skilled in the art, correctly recognizes PMR-15 as a composite using polyimide as a matrix rather than as stated in the Wiley specification. As understood, Wiley is directed to a clamp with a mechanically attached grommet which does not have loose parts during maintenance. The clamp of Wiley et al. specifically teaches making the clamping shells form PMR-15 polyimide matrix and graphite fiber of random orientation. Alston et al. as understood, properly discloses PMR-15 as including a polyimide matrix. Alston et al. improves the room temperature storage stability of PMR monomer solutions. As understood, Yamamoto et al. achieves a molded composite article by laminating a layer of filaments on an extensible resinous film to provide a laminate. The layer

of filaments itself may be impregnated with a layer of resinous adhesive or resin (see col.5, line 23-25 and Fig. 3). The laminate is a layer of extensible resinous film bonded to a layer of filaments, which is clearly evident from Figs. 5 and 6.

Wiley clearly does not disclose the stacking of multiple sheets in the mold to form a tube clamp, nor would it be expected to, as it clearly discloses the use of graphite fibers of random orientation. Thus there is no teaching or suggestion in Wiley to form the tube clamp by stacking of multiple sheets. Although the Examiner indicates that stacking multiple sheets in a mold is well-known and conventional, applicants invention is not merely stacking of multiple sheets in a mold. Applicants' invention layers the plurality of sheets along the contours of the layup tooling. In this manner, the fibers are parallel to the surface of the tooling, so that after molding, the portion of the tube clamp in contact with the tube will not have fibers breaking the surface of the clamp. Mere stacking of layers to fill a mold, particularly a contoured mold, as suggested by the Examiner, are not necessarily placed in the configuration taught by applicants. Because Wiley lacks the teaching or suggestion to stack multiple sheets, it is not properly combinable with Yamamoto. However, even if such motivation was present, it would still not disclose applicants' invention, as Yamamoto produces a laminate by laminating alternating layers of filaments (with or without resin) onto layers of extensible resinous film to provide a laminate. This is not applicants' invention.

With regard to claim 2, Yamamoto teaches only what applicants teach at page 6 lines 111-21 of their specification. As noted above, Wiley provides no motivation to make the combination, as it clearly is directed at randomly oriented fibers. Furthermore, as noted above, even if such motivation existed to make the combination suggested by the examiner, one would still not obtain Applicants' invention as Applicants do not teach, as does Yamamoto, alternating layers of filaments (with or without resin) with layers of extensible resinous films.

With regard to claim 3, all that has been said above is equally applicable to this rejection. As previously noted, even if motivation existed in Wiley to stack woven or unidirectional layers to form a tube clamp as suggested by the Examiner, this alone is not applicants' invention, as one skilled in the art, without more, can arrange these plies in an almost infinite number of orientations. Applicants' invention requires stacking the layers of fiber such that the layers are

arranged along the contour of the mold so that fibers do not protrude from the surface of the tube clamp.

Regarding claims 4 and 5, applicants respectfully disagree with the Examiner's interpretation that Wiley discloses sheets containing randomly oriented fibers. Wiley, at col. 3, lines 48-50, clearly states that "The PMR-15 graphite has a composition of about 55% graphite fiber with a random orientation and about 45% polyamide matrix." There is no mention of sheets containing randomly oriented fibers. Applicants respectfully submits that Wiley discloses a discontinuously reinforced matrix formed with a fabric-resin molding compound in which the molding compound is injected into the mold and cured, producing an article with no preferred directional strength. If the Examiner is to maintain this rejection, then the Examiner is requested to cite the column and line numbers where Wiley refers to sheets containing randomly oriented fibers.

Applicants note that claim 11 has been amended. Claims 10 and 11 incorporate all of the limitations of the prior claims. The prima facie case for these rejections has been rebutted above. These claims only present Applicants' preferred methods and do not preclude the use of other methods to manufacture the tube clamp.

Applicants note that claim 12 is an independent claim similar to claim 1. However, while claim 12 envisions that each half of the tube clamp is formed in two layup tooling molds, claim 1 envisions that the tube clamp can be layed up in a single tooling mold as shown in Fig. 2. The limitations are otherwise similar to those contained in claim1.

Applicants respectfully request the withdrawal of the rejection of claims 1-5 and 10-12 based on Wiley in view of Alston et al. and further in view of Yamamoto. Applicants do not understand the significance of Clark, as the Examiner has not discussed this reference in this rejection. Applicants further request the allowance of these claims.

Claims 6-8 are rejected under 35 U.S.C. §103(a) as being unpatentable over the references as applied to claim 1 above, and further in view of the admitted prior art. The Examiner states:

> The specification does not require the shape of the clamp to have the same thickness throughout. One in the art would appreciate that the method of Wiley could be used to make any style clamp and it would have been obvious to use the method of Wiley, Alston et al., and Yamamoto et al. to form the clamps of the admitted prior art since they are both clamps used in the airline industry. When forming clamps such as in the admitted prior art one would appreciate that a filler would be needed between the top and bottom as the clamp is not the same thickness throughout. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any type of filler such as plies cut to shape since this would fill the space between the top and bottom of the clamp.

Applicants respectfully traverse this rejection. The rejection of claim 1 has been discussed above, and all that has been said with regard to the rejection of claim 1 is equally applicable to this rejection. These references are not properly combinable as discussed above. Applicants further note that Wiley does not need filler, because, as discussed above, Wiley discloses a discontinuously reinforced matrix formed with a fabric-resin molding compound in which the molding compound is injected into the mold and cured, producing an article with no preferred directional strength so that cross sectional thicknesses will not pose a problem for Wiley. Also, given the specific layups and the relationships between these lay-ups, taught by Yamamoto in Figs. 5 and 6, Yamamoto would appear to preclude the use of fillers as these relationships would be altered, negating the advantages taught by Yamamoto. Thus, Yamamoto apparently teaches away from the use of fillers. For all of the above reasons, Applicants respectfully request the withdrawal of the rejection of claims 6-8 based on Wiley in view of Alston et al. and further in view of Yamamoto. Applicants further request the allowance of these claims.

CONCLUSION

In view of the above, Applicants respectfully request entry of this amendment and reconsideration of the Application based on this amendment and withdrawal of the outstanding rejections. As a result of the amendments and remarks presented herein, Applicants respectfully submit that claims 1-12 are not rendered obvious by Wiley, Alston et al., or Yamamoto et al. either alone or in any combination and thus, are in condition for allowance. As the claims are not anticipated by nor rendered obvious in view of the applied art, Applicants request allowance

of claims 1-12. If the Examiner believes that prosecution of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact the Applicants.

The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to Deposit Account No. 50-1059.

Respectfully submitted,

Carmen Santa Maria

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MARKED UP COPY OF THE CLAIMS

11. (Amended) [The] A process [of claim 1 wherein the step of curing includes resin transfer molding] for forming a tube clamp comprising the steps of:

layering a plurality of sheets of fibers to form a fiber bundle of a preselected thickness along a contour of layup tooling having a predetermined shape;

injecting polymer into the tooling to impregnate the fiber bundle;

curing the impregnated fiber bundle to at least near net shape; then

removing said cured material from said layup tooling while retaining the shape of said layup tooling without exposing fibers.